



Europäisches Patentamt  
European Patent Office  
Office européen des brevets



(11) **EP 0 527 589 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention  
of the grant of the patent:  
**03.06.1998 Bulletin 1998/23**

(51) Int Cl.<sup>6</sup>: **C08L 23/10**

(21) Application number: **92307139.3**

(22) Date of filing: **05.08.1992**

(54) **Resin composition comprising amorphous polyolefin and crystalline polypropylene**

Harzzusammensetzung aus amorphem Polyolefin und crystallinem Polypropylen

Composition de résine de polyoléfine amorphe et de polypropylène crystalline

(84) Designated Contracting States:  
**DE FR GB**

(30) Priority: **08.08.1991 JP 223459/91**

(43) Date of publication of application:  
**17.02.1993 Bulletin 1993/07**

(73) Proprietors:  
• **UBE REXENE CORPORATION**  
Tokyo 140 (JP)  
• **UBE INDUSTRIES, LTD.**  
Ube-shi, Yamaguchi-ken 755 (JP)  
• **REXENE CORPORATION**  
Dallas, Texas 75244 (US)

(72) Inventors:  
• **Tsurutani, Iwao, c/o Ube Rexene Corporation**  
Tokyo 140 (JP)

• **Manabe, Takahumi, c/o Sakai Laboratory**  
Sakai-shi, Osaka-fu, 592 (JP)  
• **Emoto, Ikuo, c/o Sakai Laboratory**  
Sakai-shi, Osaka-fu, 592 (JP)

(74) Representative: **Perry, Robert Edward**  
**GILL JENNINGS & EVERY**  
Broadgate House  
7 Eldon Street  
London EC2M 7LH (GB)

(56) References cited:  
**EP-A- 0 119 508** **FR-A- 2 404 025**

• **DATABASE WPIL Derwent Publications Ltd.,**  
London, GB; AN 91-193173 & JP-A-3 168 234  
(IDEMITSU) 22 July 1991

Note: Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

**EP 0 527 589 B1**

## Description

### Background of the Invention and Related Art Statement

5 The present invention relates to a novel resin composition. More particularly, the present invention relates to a novel soft polypropylene resin composition having flexibility at normal temperature and a sufficient mechanical strength at high temperatures.

In recent years, soft vinyl chloride resins containing a plasticizer have been widely used as a soft resin for sheets or films. Soft vinyl chloride resins, however, may give rise to social problems such as (1) toxicity problem caused by bleed-out of plasticizer or monomer used therein and (2) acid rain derived from hydrogen chloride generated by burning thereof.

10 Meanwhile, as a soft resin comparable to the soft vinyl chloride resins, there are resins using ethylene as a main component, such as ethylene/vinyl acetate copolymer, ethylene/ethyl acrylate copolymer, ionomer, linear low-density polyethylene, ultralow-density polyethylene, ethylene/propylene copolymer and the like. These ethylene-based soft resins, however, are not balanced in flexibility and mechanical strength. That is, resins having sufficient flexibility at normal temperature tend to have a low mechanical strength at about 80°C, while resins having an excellent mechanical strength at about 80°C have low flexibility at normal temperature.

15 The provision of a polypropylene resin having excellent mechanical strength with flexibility has been attempted, by copolymerizing propylene with ethylene to obtain a propylene/ethylene copolymer having a lower melting point, sufficient mechanical strength and flexibility. However, the ethylene content is at best 5-6% by weight under the present technique; hence, it is difficult to obtain a polypropylene having flexibility comparable to that of soft vinyl chloride resins.

20 In view of the above situation, an object of the present invention is to provide a soft resin composition other than a soft vinyl chloride resin, in particular, a resin composition having excellent flexibility and mechanical strength over a temperature range from normal temperature to high temperatures.

25 Another object of the present invention is to provide a resin composition which is of low cost and which can be suitably used in various applications, for example, as a packaging film or sheet, a building material sheet in the construction field, an insulator for cable, a fiber, and a base material for tape.

FR-A-2404025 discloses a thermoplastic resin comprising a mixture of (i) a propylene/butene-1 copolymer, and (ii) an isotactic propylene resin. In one embodiment, the copolymer (i) has a heat of fusion in the range 10 to 80 J/g, preferably 20 to 70 J/g.

### Summary of the Invention

35 According to the present invention, there is provided a resin composition comprising:

- (a) 20-80% by weight of an amorphous copolymer of either i) propylene and butene-1, or ii) propylene and ethylene, said copolymer having a propylene and/or butene-1 content of 50% by weight or more, and
- (b) 80-20% by weight of a crystalline polypropylene, wherein when the other  $\alpha$ -olefin is butene-1 the copolymer has a heat of crystal fusion of less than 10J/g, and when the other  $\alpha$ -olefin is ethylene the copolymer has a heat of crystal fusion of 20J/g or less.

40 The resin composition of the present invention has sufficient flexibility while retaining the high mechanical strength inherently possessed by the polypropylene. The resin composition of the present invention gives rise to no environmental pollution as experienced with soft vinyl chloride resins which are main stream conventional soft resins.

### Brief Description of the Drawing

45 Fig. 1 is a graph showing the relationship between Shore D hardness HS (23°C) and tensile modulus (80°C), of the resin compositions of the Examples and Comparative Examples.

### Detailed Description of the Invention

50 When the propylene and/or butene-1 content in the amorphous copolymer is less than 50% by weight, the amorphous copolymer has low compatibility with the crystalline polypropylene [the component (b)], which is not preferable.

55 When the amorphous copolymer is a propylene/butene-1 copolymer, the heat of crystal fusion must be less than 10 Joule/g, and when the amorphous copolymer is a propylene/ethylene copolymer, the heat of crystal fusion must be 20 Joule/g or less. In case that the heat of crystal fusion is beyond its limitation, the amorphous copolymer has low flexibility.

Incidentally, the heat of crystal fusion is measured as follows.

The heat of crystal fusion is measured in accordance with the straight line extended to the side of lower temperatures from a curved line of specific heat obtained by differential scanning calorimetry under a condition of perfect fusion of polymer. The measurement is taken using a DSC-50 produced by Shimadzu Corporation, about 10 mg of the sample, and Indium as a caloric standard under nitrogen atmosphere with the following heating program:

In the first place, the sample is heated up to 210°C with a temperature increase of 50°C per minute. After leaving the sample at 210°C for five minutes, it is cooled down to -42°C with temperature decrease of 10°C per minute. After leaving the sample at -42°C for five minutes, the measurement is carried out from the temperature range of -40°C to 200°C with a temperature increase of 20°C per minute.

The amorphous copolymer [the component (a)] of the present invention desirably has a boiling-n-heptane insoluble (i.e. a boiling-n-heptane insoluble when subjected to Soxhlet extraction) of 70% by weight or less, preferably 60% by weight or less, particularly preferably 10% by weight or less. When the boiling-n-heptane insoluble is more than 70% by weight, the proportion of the amorphous portion in the amorphous copolymer is small, making it impossible to obtain a resin composition having desired sufficient flexibility. The amorphous copolymer [the component (a)] desirably has a number-average molecular weight of 1,000-200, 000, preferably 1,500-100, 000.

The boiling-n-heptane insoluble was measured by the method of Soxhlet extraction, using 2 g of cubes with each side measuring between 3 and 5 mm.

In the present invention, it is possible to use one or more amorphous copolymers.

The amorphous copolymer can be produced from raw materials containing propylene in a desired proportion. It can be obtained by, for example, polymerizing raw material monomers using (a) a titanium catalyst supported on magnesium chloride and (b) triethylaluminum, in the presence or absence of hydrogen. Use of an amorphous copolymer produced from raw materials is preferable in view of its stable supply and stable quality. Alternatively a commercial product may be used, if there is an appropriate commercial product.

Specific examples of the amorphous copolymer [the component (a)] include those containing propylene as a main component and having properties mentioned above, such as propylene/ethylene copolymer, propylene/butene-1 copolymer, propylene/butene-1/ethylene terpolymer, and the like.

When a propylene/ethylene copolymer is used as the amorphous copolymer it desirably contains an ethylene component in an amount of 0-30% by weight, preferably 1-20% by weight. When the amount of the ethylene component is larger than 30% by weight, the resulting resin composition is too soft, has high surface tackiness, and is inconvenient to handle. When a propylene/butene-1 copolymer is used as the amorphous copolymer it desirably contains a butene-1 component in an amount of 0-50% by weight, preferably 1-50% by weight and most preferably 10-50% by weight. When the amount of the butene-1 component is larger than 50% by weight, the resulting resin composition has too low a softening point.

As the amorphous copolymer [the component (a)] of the present invention, a propylene/butene-1 copolymer containing a butene-1 component in an amount of 10-50% by weight is preferably used because it is superior in tensile elongation, impact resilience and cohesiveness. An example of such a copolymer is REXTAC (a commercial product) of REXENE Co. of U.S.

The crystalline polypropylene [the component (b)] of the present invention refers to an isotactic polypropylene insoluble in boiling n-heptane and includes commercially available polypropylenes used for extrusion, injection molding, blow molding, etc. It may be a propylene homopolymer, or a copolymer between an isotactic polypropylene of stereoregularity and other  $\alpha$ -olefin.

As the crystalline polypropylene [the component (b)], there may be used a commercial product or a manufactured product. The production of crystalline polypropylene is not critical and can be conducted using a process appropriately selected from conventional processes used for production of crystalline polypropylene.

When an  $\alpha$ -Olefin is used in copolymerization with the crystalline polypropylene it is preferably an  $\alpha$ -olefin of 2-8 carbon atoms, such as ethylene, butene-1, pentene-1, hexene-1, heptene-1, octene-1 or the like. Of these, ethylene or butene-1 is particularly preferable.

Preferably the crystalline polypropylene [the component (b)] of the present invention is selected from a propylene homopolymer; a propylene/ethylene random or block copolymer having an ethylene component content of 1-30% by weight, preferably 2-25% by weight; a propylene/butene-1 random or block copolymer having a butene-1 component content of 1-20% by weight. Of these, a propylene/butene-1 copolymer is particularly preferable in view of the applications (film or sheet) of the present resin composition.

The crystalline polypropylene [the component (b)] can be used singly or in combination of two or more of (co) polymers.

In the present invention, the component (a) and/or the component (b) may be used in modified form. That is, the component (a) or (b) may be used after being modified with an unsaturated carboxylic acid (e.g. acrylic acid, methacrylic acid, ethacrylic acid, maleic acid, fumaric acid, itaconic acid) and/or its derivative (e.g. ester, acid anhydride, metal salt). Of the modified products, preferable is a product modified with maleic anhydride or itaconic anhydride, and more

preferable is a product modified with maleic anhydride.

The production of the present resin composition comprising the components (a) and (b) is not critical and can be carried out by a method ordinarily used in the production of conventional polypropylene composition, wherein melt kneading is conducted with heating, using, for example, a kneader (e.g. kneader, Banbury mixer, rolls) or a single-screw or twin-screw extruder.

The present resin composition may contain, as necessary, various additives, reinforcing agents and fillers, such as heat stabilizer, antioxidant, light stabilizer, antistatic agent, lubricant, nucleating agent, flame retardant, pigment or dye, glass fiber, carbon fiber, calcium carbonate, calcium sulfate, barium sulfate, magnesium hydroxide, mica, talc and clay.

The present resin composition may further contain, as necessary, other thermoplastic resins, elastomers and rubbers. It is possible that these resins, elastomers and rubbers be compounded so as to form a crosslinked structure.

The resin composition of the present invention can be obtained by compounding the component (a) and the component (b) so that the content of the component (a) becomes 20-80% by weight, preferably 25-75% by weight. When the content of the component (a) is less than 20% by weight, the resulting resin composition has a Shore hardness Hs (23°C) of more than 60 and has no sufficient flexibility. When the content of the component (a) is more than 80% by weight, the resin composition has a Shore hardness Hs (23°C) of less than 8, is too soft at normal temperature, has a tensile modulus (80°C) of less than 30 kg/cm<sup>2</sup>, and is unable to keep its own shape and mechanical strength satisfactorily.

In compounding the component (a) and the component (b) to obtain the present resin composition, it is preferable to control the Shore D hardness Hs (23°C) of the present resin composition at 8 to 60 and the tensile modulus (80°C) at 30 kg/cm<sup>2</sup> to less than 2,000 kg/cm<sup>2</sup>.

More preferably, the shore D hardness Hs (23°C) and the common logarithm of the tensile modulus (80°C) satisfy the following formulas (1) and (2) because the resulting resin composition has higher flexibility at normal temperature, shows no reduction in mechanical strength at about 80°C, and is well balanced in flexibility and mechanical strength.

$$10 \leq Hs (23^{\circ}C) \leq 55 \quad (1)$$

$$y \geq 0.04163Hs (23^{\circ}C) + 0.8665 \quad (2)$$

In the present invention, Shore D hardness Hs (23°C) and tensile modulus (80°C) were measured in accordance with the following methods.

#### Shore D hardness Hs (23°C)

A resin composition was subjected to press molding consisting of 2 minutes of preheating, 1 minute of pressing (temperature = 180°C, pressure = 100 kg/cm<sup>2</sup>) and 3 minutes of cooling, to obtain a sheet of 2 mm in thickness.

The sheet was kept in a constant-temperature room of 23°C and piled in 6 layers (6 sheets), after which a hardness meter was pressed upon the uppermost layer and, after 5 seconds, the hardness of the sheet was measured.

#### Tensile modulus (80°C)

The sheet obtained in the same manner as above was subjected to punching using a JIS No. 2 type dumbbell, to obtain a test piece.

The test piece having a sectional area of S cm<sup>2</sup> was subjected to a tensile test (crosshead speed = 50 mm/min, distance between chucks = 5 cm, chart speed = 50 cm/min) in a constant-temperature chamber to measure a tensile load X kg when 2% distortion occurred, while reading the displacement of the distance between chucks on the chart. The tensile modulus (80°C) of the test piece was calculated from the S and X obtained, using the following formula (3).

$$\begin{aligned} \text{Tensile modulus (80}^{\circ}\text{C) (kg/cm}^2\text{)} \\ = [X/S]/[2/100] = 100X/2S \end{aligned} \quad (3)$$

As mentioned above, the resin composition of the present invention has excellent flexibility at normal temperature and a high mechanical strength at about 80°C, and can be used alone as a resin for film, sheet, bottle, pipe, fibrous material, porous film and other general molded articles, all of which have heretofore been made of a soft polymer. The

molding of the present resin composition into the above articles can be conducted by an ordinary molding method such as extraction, injection molding, blow molding, press molding or stretching. A film, a sheet and a blown bottle made of a single layer of the present resin composition can be used in various applications.

The resin composition of the present invention can also be used as a composite material with other polymer or the like, such as laminate with leather or polyvinyl chloride, laminate with polypropylene, polyethylene, nylon or polyester, laminate with woven cloth or unwoven cloth, or other laminate. Examples of the laminates are a crystalline polypropylene/the present resin composition, a crystalline polypropylene/the present resin composition/a crystalline polypropylene and a crystalline polypropylene/the present resin composition/a polyethylene; and such laminates can reduce the surface tackiness of the present resin composition or can improve the surface hardness of the present resin composition. Said laminates can further have thereon a layer of good-gas-barrier resin [e.g. Eval (trade name) manufactured by KURARAY Co., Ltd.] to impart selective gas permeability, whereby a multi-layered film, a multi-layered sheet or a multi-layered bottle can be obtained.

The present resin composition can also be used as a foamed material. The molded articles obtained from the present resin composition can be subjected to known surface treatments such as coating and vapor deposition.

The present invention is hereinafter described in detail by way of Examples. However, the present invention is by no means restricted by the Examples.

In the Examples, melting point was measured by using a differential scanning calorimeter, under the conditions of temperature elevation rate = 10 °C/min and helium flow rate = 100 ml/min.

#### Examples 1-4

As the amorphous copolymer [the component (a)], there was used REXTAC RT 2780 (trade name) which was a propylene/butene-1 copolymer manufactured by U.S. Rexene Co., having a propylene/butene-1 weight ratio of 65/35, a number-average molecular weight Mn of 6,500, a heat of crystal fusion of 7.2 Joule/g and a n-heptane insoluble of 5% by weight. As the crystalline polypropylene [the component (b)], there was used POLYPROPYLENE RF 355B (trade name) which was a polypropylene manufactured by Ube Industries, Ltd., having an MFR of 2.7 and an ethylene content of 4% by weight. The two components were melt-mixed in component ratios shown in Table 1, in a stainless steel beaker heated at 180°C, to obtain resin compositions.

The resin compositions were measured for Shore D hardness Hs (23° C), tensile modulus (80° C) and melting point by the methods mentioned above. The results are shown in Table 1.

Table 1

	Example			
	1	2	3	4
Component ratio (% by weight)				
Component (a): RT2780	80	60	40	20
Component (b): RF355B	20	40	60	80
Properties				
Melting point (° C)	138	138	138	138
Hs (23° C)	16	28	42	53
Tensile modulus (80° C) (kg/cm <sup>2</sup> )	45	164	520	1355
Function				
y	1.6532	2.2148	2.7160	3.1319
0. 0 4163Hs + 0.8665	1.5326	2.0321	2.6150	3.0729

#### Examples 5-8

Resin compositions were obtained in the same manner as in Example 1 except that as the component (a), there was used REXTAC RT2585 (trade name) which was a propylene/ethylene copolymer manufactured by U.S. Rexene Co., having a propylene/ethylene weight ratio of 85/15, a number-average molecular weight Mn of 7,100, a heat of crystal fusion of 4.7 Joule/g and a n-heptane insoluble of 0.7% by weight and, as the component (b), there was used FM801 (trade name) which was a polypropylene manufactured by Union Polymer K.K., having an MFR of 9 and an ethylene content of 5.7% by weight and that the two components were used in ratios shown in Table 2.

The resin compositions were measured for Shore D hardness Hs (23° C), tensile modulus (80° C) and melting

# EP 0 527 589 B1

point in the same manners as in Example 1. The results are shown in Table 2.

Table 2

	Example			
	5	6	7	8
Component ratio (% by weight)				
Component (a): RT2585	80	60	40	20
Component (b): FM801	20	40	60	80
Properties				
Melting point (° C)	132	132	132	132
Hs (23° C)	13	24	33	47
Tensile modulus (80° C) (kg/cm <sup>2</sup> )	46	176	451	1083
Function				
y	1.6628	2.2455	2.6542	3.0346
0. 0 4163Hs + 0.8665	1.4077	1.8656	2.2403	2.8231

## Examples 9-12

Resin compositions were obtained in the same manner as in Example 1 except that REXTAC RT2780 used in Example 1 was used as the component (a) and FM801 used in Example 5 was used as the component (b) and that the two components were used in ratios shown in Table 3.

The resin compositions were measured for Shore D hardness Hs (23°C), tensile modulus (80°C) and melting point in the same manners as in Example 1. The results are shown in Table 3.

Table 3

	Example			
	9	10	11	12
Component ratio (% by weight)				
Component (a): RT2780	80	60	40	20
Component (b): FM801	20	40	60	80
Properties				
Melting point (° C)	132	132	132	132
Hs (23° C)	12	29	41	50
Tensile modulus (80° C) (kg/cm <sup>2</sup> )	40	145	439	1127
Function				
y	1.6021	2.1614	2.6425	3.0519
0. 0 4163Hs + 0.8665	1.3661	2.0738	2.5733	2.9480

## Comparative Example 1

A sheet of 2 mm in thickness was prepared from POLYPROPYLENE RF 355B [used in Example 1 as the component (B)] alone, in the same manner as in the test piece preparation mentioned above with respect to the test methods for Shore D hardness (23° C) and tensile modulus (80° C).

Using the sheet, Shore D hardness Hs (23° C), tensile modulus (80 °C) and melting point were measured in the same manners as in Example 1. The results are shown in Table 4.

## Comparative Examples 2-3

Resin compositions were obtained in the same manner as in Example 1 except that the component (a)/component (b) ratios were as shown in Table 4.

## EP 0 527 589 B1

The resin compositions were measured for Shore D hardness Hs (23° C), tensile modulus (80° C) and melting point in the same manners as in Example 1. The results are shown in Table 4.

### Comparative Example 4

A sheet of 2 mm in thickness was prepared from FM801 [used in Example 5 as the component (B)] alone, in the same manner as in the test piece preparation mentioned above with respect to the test methods for Shore D hardness (23° C) and tensile modulus (80° C).

Using the sheet, Shore D hardness Hs (23° C), tensile modulus (80° C) and melting point were measured in the same manners as in Example 1. The results are shown in Table 4.

Table 4

	Comparative Example			
	1	2	3	4
Component ratio (% by weight)				
Component (a)	-	RT2780 10	RT2780 90	-
Component (b)	RF355B 100	RF355B 90	RF355B 10	FM801 100
Properties				
Melting point (°C)	138	138	138	132
Hs (23°C)	62	58	8	60
Tensile modulus (80° C) (kg/cm <sup>2</sup> )	2500	2000	24	1938
Function				
y	3.3979	3.3010	1.3802	3.2874
0. 0 4163Hs + 0.8665	3.4476	3.2810	1.8656	3.3643

### Comparative Examples 5-10

Sheets of 2 mm in thickness were prepared using only one of the following resins, in the same manner as in Comparative Example 1.

Z517 (trade name), a very low-density polyethylene manufactured by Ube Industries, Ltd., of MI = 2.0 g/10 min and density = 0.906 g/cm<sup>3</sup> (Comparative Example 5)

640UF (trade name), a high-density polyethylene manufactured by Idemitsu Petrochemical K.K., of MI = 0. 0 5 g/10 min and density = 0.955 g/cm<sup>3</sup> (Comparative Example 6)

FA120N (trade name), linear low-density polyethylene manufactured by Ube Industries, Ltd., of MI = 1.0 g/10 min and density = 0.920 g/cm<sup>3</sup> (Comparative Example 7)

L719 (trade name), a low-density polyethylene manufactured by Ube Industries, Ltd., of MI = 7.5 g/10 min and density = 0.918 g/cm<sup>3</sup> (Comparative Example 8)

V315 (trade name), an ethylene/vinyl acetate copolymer manufactured by Ube Industries, Ltd., of MI = 17 g/10 min and vinyl acetate content = 15% by weight (Comparative Example 9)

J109 (trade name), a homopolypropylene manufactured by Ube Industries, Ltd., of MFR = 9 g/10 min (Comparative Example 10)

Using the sheets, Shore D hardness Hs (23°C), tensile modulus (80° C) and melting point were measured in the same manners as in Example 1. The results are shown in Table 5.

Table 5

	Comparative Example					
	5	6	7	8	9	10
Resin component	Z517	640UF	FA120N	L719	V315	J109

Table 5 (continued)

Properties	Comparative Example					
Melting point (° C)	114	130	123	109	90	167
Hs (23° C)	36	59	49	46	34	70
Tensile modulus(80° C) (kg/cm <sup>2</sup> )	177	2282	663	188	152	6065
Function						
y	2.2480	3.3583	2.8215	2.2742	2.1818	3.7828
0. 04163Hs + 0.8665	2.3652	3.3227	2.8614	2.7815	2.2819	3.7806

As is clear from the above Examples, the resin compositions of the present invention have flexibility at normal temperature and a tensile modulus of 30 kg/cm<sup>2</sup> or more at 80°C.

Based on the above Examples and Comparative Examples, the relation of (a) Shore D hardness (23°C) and (b) tensile modulus (80°C) is shown in Fig. 1 by taking the abscissa for (a) and the ordinate (expressed in logarithm) for (b). It is appreciated from Fig. 1 that the resin compositions of the present invention satisfy the formulas (1) and (2) shown above and are well balanced in flexibility and mechanical strength. Fig. 1 that the resin compositions of the present invention satisfy the formulas (1) and (2) shown above and are well balanced in flexibility and mechanical strength.

Incidentally, in each of Tables 1-5 are shown the common logarithm of tensile modulus (80°C) and the right side [0. 04163Hs (23°C) + 0.8665] of the above formula (2) corresponding to the straight line Z in Fig. 1.

## Claims

1. A resin composition comprising:

- (a) 20-80% by weight of an amorphous copolymer of either i) propylene and butene-1, or ii) propylene and ethylene, said copolymer having a propylene and/or butene-1 content of 50% by weight or more, and  
(b) 80-20% by weight of a crystalline polypropylene, characterised in that when the copolymer is a propylene/butene-1 copolymer it has a heat of crystal fusion of less than 10 J/g, and when the copolymer is a propylene/ethylene copolymer it has a heat of crystal fusion of 20 J/g or less.

2. A resin composition according to claim 1, wherein the copolymer has a boiling-n-heptane insolubility of 70% by weight or less.

3. A resin composition according to claim 1, wherein the copolymer has a boiling-n-heptane insolubility of 10% by weight or less.

4. A resin composition according to claim 1, wherein the copolymer is a propylene/ethylene copolymer having an ethylene component content of 0-30% by weight.

5. A resin composition according to claim 1, wherein the copolymer is a propylene/butene-1 copolymer having a butene-1 component content of 1-50% by weight.

6. A resin composition according to claim 1, wherein the copolymer is a propylene/butene-1/ethylene terpolymer.

7. A resin composition according to claim 1, wherein the Shore D hardness Hs (23°C) and the common logarithm y of the tensile modulus (80°C) satisfy the following formulae (1) and (2):

$$10 \leq Hs (23^\circ C) \leq 55 \quad (1)$$

$$y \geq 0.04163Hs (23^\circ C) + 0.8665 \quad (2)$$

## Patentansprüche

### 1. Harzzusammensetzung umfassend:

(a) 20-80 Gew.-% eines amorphen Copolymers von entweder i) Propylen und Buten-1 oder ii) Propylen und Ethylen, wobei das Copolymer einen Propylen- und/oder Buten-1-Gehalt von 50 Gew.-% oder mehr aufweist, und

(b) 80-20 Gew.-% eines kristallinen Polypropylens,

dadurch gekennzeichnet, daß sie eine Kristallschmelzwärme von weniger als 10 J/g besitzt, wenn das Copolymer ein Propylen/Buten-1-Copolymer ist, und sie eine Kristallschmelzwärme von 20 J/g oder weniger besitzt, wenn das Copolymer ein Propylen/Ethylen-Copolymer ist.

2. Harzzusammensetzung nach Anspruch 1, worin das Copolymer eine Unlöslichkeit in siedendem n-Heptan von 70 Gew.-% oder weniger besitzt.

3. Harzzusammensetzung nach Anspruch 1, worin das Copolymer eine Unlöslichkeit in siedendem n-Heptan von 10 Gew.-% oder weniger besitzt.

4. Harzzusammensetzung nach Anspruch 1, worin das Copolymer ein Propylen/Ethylen-Copolymer mit einem Gehalt an Ethylen-Komponente von 0-30 Gew.-% ist.

5. Harzzusammensetzung nach Anspruch 1, worin das Copolymer ein Propylen/Buten-1-Copolymer mit einem Gehalt an Buten-1-Komponente von 1-50 Gew.-% ist.

6. Harzzusammensetzung nach Anspruch 1, worin das Copolymer ein Propylen/Buten-1/Ethylen-Terpolymer ist.

7. Harzzusammensetzung nach Anspruch 1, worin die Shore D-Härte  $H_s$  (23°C) und der Zehnerlogarithmus  $y$  des Zugmoduls (80°C) die folgenden Formeln (1) und (2) erfüllen:

$$10 \leq H_s (23^\circ\text{C}) \leq 55 \quad (1)$$

$$y \geq 0,04163 H_s (23^\circ\text{C}) + 0,8665 \quad (2)$$

## Revendications

### 1. Composition de résine comprenant :

(a) 20 à 80 % en poids d'un copolymère amorphe soit i) de propylène et de butène-1, soit ii) de propylène et d'éthylène, ce copolymère ayant une teneur en propylène et/ou en butène-1 de 50 % en poids ou davantage, et  
(b) 80 à 20 % en poids d'un polypropylène cristallin, caractérisé en ce que lorsque le copolymère est un copolymère propylène/butène-1, il a une chaleur de fusion des cristaux inférieure à 10 J/g et en ce que lorsque le copolymère est un copolymère propylène/éthylène, il a une chaleur de fusion des cristaux de 20 J/g ou moins.

2. Composition de résine selon la revendication 1, dans laquelle le copolymère a une insolubilité dans le n-heptane bouillant de 70 % en poids ou moins.

3. Composition de résine selon la revendication 1, dans laquelle le copolymère a une insolubilité dans le n-heptane bouillant de 10 % en poids ou moins.

4. Composition de résine selon la revendication 1, dans laquelle le copolymère est un copolymère propylène/éthylène ayant une teneur en constituant éthylène de 0 à 30 % en poids.

5. Composition de résine selon la revendication 1, dans laquelle le copolymère est un copolymère propylène/butène-

## EP 0 527 589 B1

1 ayant une teneur en constituant butène-1 de à 50 % en poids.

6. Composition de résine selon la revendication 1, dans laquelle le copolymère est un terpolymère propylène/ butène-1/éthylène.

5

7. Composition de résine selon la revendication 1, dans laquelle la dureté Shore D Hs (à 23 °C) et le logarithme décimal y du module de traction (à 80 °C) satisfont aux formules (1) et (2) suivantes :

10

$$10 \leq Hs (23 \text{ }^{\circ}\text{C}) \leq 55 \quad (1)$$

$$y \geq 0,0416 Hs (23 \text{ }^{\circ}\text{C}) + 0,8665 \quad (2)$$

15

20

25

30

35

40

45

50

55

FIG. 1

